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DECLARATION

I, Atsuko SANABE, translator of the attached document, do hereby certify that to the best of my knowledge and belief the attached document is a true English translation of Japanese Patent Application No. 2001-76030 filed to the Japan Patent Office on March 16, 2001.

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[List of Attached Documents]

[Name of Document] Specification 1

[Name of Document] Drawing 1

[Name of Document] Abstract 1

[General Power of Attorney No.] 9808671

[Necessity of Proof] Necessary

[Name of Document] Specification

[Title of the Invention] Liquid Developing Device

[Scope of Claims]

[Claim 1]

A liquid developing device that applies a liquid developer consisting of a carrier liquid and toner dispersed therein to an elastic developing roller, brings the developing roller by pressure into contact with a latent image carrier where an electrostatic latent image is formed, develops the electrostatic latent image using the liquid developer applied to the developing roller, and simultaneously removes the toner adhering to the background of the latent image carrier using a sweep roller, the liquid developing device being characterized in that the developing roller comes into contact with and separates from the latent image carrier.

[Claim 2]

The liquid developing device as described in claim 1, characterized in that, when the developing roller comes into contact with the latent image carrier or separates from the latent image carrier, both the developing roller and the latent image carrier are

rotating.

[Claim 3]

The liquid developing device as described in claim 1, characterized in that, when the developing roller comes into contact with the latent image carrier or separates from the latent image carrier, the liquid developer is deposited on the surface of the developing roller.

[Claim 4]

The liquid developing device as described in claim 1, characterized in that, when the developing roller comes into contact with the latent image carrier or separates from the latent image carrier, a predetermined potential is given to the latent image carrier for preventing toner from moving to the latent image carrier from the surface of the developing roller.

[Claim 5]

A liquid developing device that applies a liquid developer consisting of a carrier liquid and toner dispersed therein to an elastic developing roller, brings the developing roller by pressure into contact with a latent image carrier where an electrostatic latent image is formed, develops the electrostatic latent image using the liquid developer applied to the developing roller, and simultaneously removes the toner adhering to the background of the latent image carrier using a sweep roller, the liquid developing device being characterized in that a distance d1 from the developing roller to the sweep roller in the rotating direction of the latent image carrier and a linear speed v of the latent image carrier satisfy a following relation:

$$d1 / v < 0.5$$

where a unit of the distance d1 is mm, and a unit of the linear speed of the latent image carrier is mm/sec.

[Claim 6]

The liquid developing device as described in claim 5, characterized in that a distance d2 from the sweep roller to a transfer

position in the rotating direction of the latent image carrier satisfies a following relation:

$$d2 / v < 0.7.$$

[Claim 7]

The liquid developing device as described in claim 5 or claim 6, characterized in that the latent image carrier is a photoreceptor made of amorphous silicon.

[Detailed Description of the Invention]

[0001]

[Field of the Invention]

The present invention relates to an improved liquid developing device, a so-called wet-type developing device, which performs developing using a liquid developer consisting of a carrier liquid with toner dispersed therein, used for image formation apparatuses such as electrophotographic copiers, printers, or facsimiles.

[0002]

[Background Art]

Conventionally, there has been known a liquid developing device that applies a liquid developer consisting of a carrier liquid and toner dispersed therein to an elastic developing roller, brings the developing roller by pressure into contact with a photoreceptor as a latent image carrier where an electrostatic latent image is formed, develops the electrostatic latent image using the liquid developer applied to the developing roller, and simultaneously removes the toner adhering to the background of the latent image carrier using a sweep roller.

[0003]

The conventional liquid developing device forms a predetermined contact width (nip) by bringing the developing roller into contact with the photoreceptor and pressuring the roller against the photoreceptor, moves the toner dispersed in the liquid developer adhering to the developing roller to the photoreceptor, and adheres the toner to an electrostatic latent image formed on the photoreceptor

to visualize the electrostatic latent image thereon.

[0004]

[Problems to be Solved by the Invention]

However, the conventional liquid developing device is so constructed that the developing roller is always pressurized against and in contact with the photoreceptor. Therefore, if the developing roller is kept in contact with the photoreceptor for a long time, distortion may occur in the developing roller. Further, there is another problem that the surface of the photoreceptor in contact with the developing roller may be soiled.

[0005]

Therefore, it is conceivable that the developing roller is separated from the photoreceptor when the liquid developing device is not in use. However, if the photoreceptor and the developing roller are brought into contact with or separated from each other, there is a fear that the surface of the developing roller and the surface of the photoreceptor may be damaged or scratched due to a difference between a rotating speed of the photoreceptor and that of the developing roller.

[0006]

Also, there is a case that an abnormal discharge may occur immediately before the developing roller comes into contact with the photoreceptor or immediately after the developing roller separates from the photoreceptor due to a potential difference between the surface of the developing roller and that of the photoreceptor, whereby the surface of the developing roller or the surface of the photoreceptor may be damaged.

[0007]

Further, the toner adheres to the photoreceptor, which causes the toner consumption to increase.

[0008]

[Means for Solving the Problems]

A liquid developing device as described in claim 1 applies a

liquid developer consisting of a carrier liquid and toner dispersed therein to an elastic developing roller, brings the developing roller by pressure into contact with a latent image carrier where an electrostatic latent image is formed, develops the electrostatic latent image using the liquid developer applied to the developing roller, and simultaneously removes the toner adhering to the background of the latent image carrier using a sweep roller, and the liquid developing device is characterized in that the developing roller comes into contact with and separates from the latent image carrier.

[0009]

According to the invention as described in claim 1, permanent distortion of the developing roller due to the pressure/contact may be eliminated and the reliability and durability of the developing roller may be improved.

[0010]

The liquid developing device as described in claim 2 is characterized in that, when the developing roller comes into contact with the latent image carrier or separates from the latent image carrier, both the developing roller and the latent image carrier are rotating.

[0011]

According to the invention as described in claim 2, when the developing roller comes into contact with the latent image carrier or separates from the latent image carrier, both the developing roller and the latent image carrier are configured to be rotating. Therefore, an abrasion and breakage of the developing roller and the latent image carrier caused by being rubbed against each other of these two members may be prevented.

[0012]

The liquid developing device as described in claim 3 is characterized in that, when the developing roller comes into contact with the latent image carrier or separates from the latent image

carrier, the liquid developer is deposited on the surface of the developing roller.

[0013]

According to the invention as described in claim 3, damage of the surface of the developing roller or the surface of the latent image carrier due to an abnormal discharge occurring immediately before the developing roller comes into contact with the photoreceptor or immediately after the developing roller separates from the photoreceptor may be prevented.

[0014]

The liquid developing device as described in claim 4 is characterized in that, when the developing roller comes into contact with the latent image carrier or separates from the latent image carrier, a predetermined potential is given to the latent image carrier for preventing toner from moving to the latent image carrier from the surface of the developing roller.

[0015]

According to the invention as described in claim 4, toner dissipation may be prevented when the developing roller comes into contact with the latent image carrier or separates from the latent image carrier.

[0016]

A liquid developing device as described in claim 5 applies a liquid developer consisting of a carrier liquid and toner dispersed therein to an elastic developing roller, brings the developing roller by pressure into contact with a latent image carrier where an electrostatic latent image is formed, develops the electrostatic latent image using the liquid developer applied to the developing roller, and simultaneously removes the toner adhering to the background of the latent image carrier using a sweep roller, and the liquid developing device is characterized in that a distance d1 from the developing roller to the sweep roller in the rotating direction of the latent image carrier and a linear speed v of the latent image

carrier satisfy a following relation:

$$d1 / v < 0.5$$

where a unit of the distance d1 is mm, and a unit of the linear speed of the latent image carrier is mm/sec.

[0017]

According to the invention as described in claim 5, a time required until the contact part of the photoreceptor with the developing roller reaches the sweep roller is set to 0.5 sec or below, thus obtaining excellent developing characteristics with less image degradation.

[0018]

The liquid developing device as described in claim 6 is characterized in that a distance d2 from the sweep roller to a transfer position in the rotating direction of the latent image carrier satisfies a following relation:

$$d2 / v < 0.7.$$

[0019]

where the unit of the interval d1 is mm.

[0020]

According to the invention as described in claim 6, a time required until the contact part of the photoreceptor with the developing roller reaches the sweep roller is set to 0.7 sec or below, thus obtaining excellent developing characteristics with less image degradation.

[0021]

The liquid developing device as described in claim 7 is characterized in that the latent image carrier is a photoreceptor made of amorphous silicon.

[0022]

According to the invention as described in claim 7, the liquid developing device is made of amorphous silicon having a high dielectric constant, thus improving an effective developing electric field.

[0023]

[Preferred Embodiments of the Invention]

Fig. 1 is a schematic diagram showing an embodiment of the invention in which the developing device according to the present invention is applied to an electrophotographic copier as an example of the image formation apparatus.

[0024]

In Fig. 1, the reference numeral 1 denotes a photoreceptor drum as a latent image carrier. A charging roller 2, a developing roller 42, a sweep roller 43, and a transfer device 5 are serially arranged around the photoreceptor drum 1 in its rotating direction. The cleaning device 6 is disposed between the transfer device 5 and the charging roller 2, and the exposing device 3 is disposed between the charging roller 2 and the developing roller 42.

[0025]

The developing roller 42 is brought into contact with the photoreceptor drum 1 with a predetermined pressure during use, and a prescribed nip width is formed between the photoreceptor drum 1 and the developing roller 42.

[0026]

Although amorphous silicon is used here as a material of the photoreceptor drum 1, the material is not limited to this. However, by using the amorphous silicon with a high dielectric constant, an effective development electric field can be improved.

[0027]

The developing roller 42 constitutes a part of the developing device 4. The outline of the electrophotographic copier will be explained first and the details of the developing device 4 will be explained later.

[0028]

The photoreceptor drum 1 is driven to rotate in the direction of the arrow by a driving unit such as a motor, not shown, and the surface of the photoreceptor drum 1 is uniformly charged to about 600 volts by the charging roller 2 while being rotated.

[0029]

After the charging, when the charged portion of the photoreceptor drum 1 reaches an area facing the exposing device 3, the light for image formation is irradiated from the exposing device 3 to the charged area of the photoreceptor drum 1 to form an image, and an electrostatic latent image is formed on the photoreceptor drum 1.

[0030]

Thereafter, the portion of the photoreceptor drum 1, where the electrostatic latent image has been formed, is developed while passing through the developing roller 42, toner adheres to the portion irradiated and image-formed with the image formation light to visualize the electrostatic latent image, and the toner image is formed on the surface of the photoreceptor drum 1.

[0031]

Subsequently, the sweep roller 43 removes fogging toner and excess carrier liquid adhering to the background of the photoreceptor drum 1. After the removal, the developed portion of the photoreceptor drum 1 reaches the transfer position, and the transfer device 5 transfers the toner to a transfer paper P. The photoreceptor drum 1 shifts to the next copying cycle through removal of residual toner by the cleaning device 6 and removal of residual charges by the discharge lamp not shown. After the image is transferred, the transfer paper P is fixed by the fixing device, not shown, and ejected to the outside of the electronic copier.

[0032]

Various types of transfer methods as follows can be used for the transfer device 5, such as a transfer method using an electrostatic roller, transfer method based on corona discharge, adhesive transfer method, or a thermal transfer method. Various types of systems as follows can be used for the fixing device, such as a thermal transfer system, solvent fixing system, or a pressuring and fixing system. Further, there is no need to directly transfer the image to the transfer

paper P, thus any intermediate transfer body such as a transfer belt and a transfer roller may be used to transfer the image thereto.

[0033]

The developing device 4 has a tank 41 for accommodation of developer, and the developer accommodation tank 41 stores developer 40. Liquid developer with low viscosity (about 1 cSt) and low concentration (about 1%) based on conventionally available Isopar (trademark of Exxon) as a carrier liquid is not used for the developer 40, but a highly viscous and highly concentrated liquid developer is desirably used.

[0034]

As a range of the viscosity and concentration of the developer 40, for example, any developer having the viscosity within a range from 50 cSt to 5000 cSt and the concentration within a range from 5% to 40% is used. As a carrier liquid, any highly insulating liquid carrier such as silicone oil, normal paraffin, Isopar M (trademark: Exxon), vegetable oil, or mineral oil is used. The toner particles are dispersed in the carrier liquid. The toner particles range in size from submicrons to about 6 μm, and any particle size is selected in accordance with each purpose as required.

[0035]

An agitating roller 46 and gear pumps 45 are disposed within the developer accommodation tank 41. A gravure roller (applying roller) 44 and a doctor blade 49 are disposed near the liquid level of the liquid developer 40 in the developer accommodation tank 41. Conductive elastic body layers 42a and 43a are provided around the outer circumferential surface of the developing roller 42 and sweep roller 43, respectively. For example, urethane rubber is used for the material forming the elastic body layers 42a and 43a, and desirably has JIS-A Standard rubber hardness of 50 degrees or below, but the hardness is not limited thereto. Therefore, any material that has conductivity and does not swell by or dissolve in a solvent may be used. The sweep roller 43 is constructed to have a surface smoothness

of 3 μm or below as the roughness Rz according to JIS Standard by coating the main body of the sweep roller or shielding it with a tube.

[0036]

The liquid developer 40 is supplied to the developing roller 42 through the gravure roller 44 and is deposited thereon. During this processing, the amount of supply of the liquid developer to the developing roller 42 is regulated by the doctor blade 49.

[0037]

A cleaning member 47 accompanies the developing roller 42, and a cleaning member 48 accompanies the sweep roller 43, and thus, the respective developer adhering to the developing roller 42 and sweep roller 43 is removed. Each of the cleaning members 47 and 48 here employs a blade system, but may employ a roller system.

[0038]

The developing roller 42, gravure roller 44, doctor blade 49, and the cleaning member 47 are supported by a bracket 51, and the bracket 51 is brought upward and downward by a cum mechanism not shown, whereby the developing roller 42 can come into contact with or separate from the photoreceptor drum 1 in the A-A direction indicated by the arrows. Fig. 2 shows a state where the developing roller 42 separates from the photoreceptor drum 1. Note that the developer accommodation tank 41 may be so constructed as to go up and down together with the developing roller 42.

[0039]

When the developing device 4 is not in use, the developing roller 42 is separated from the photoreceptor drum 1. When the developing device 4 is in use, the photoreceptor drum 1 starts rotating, and when the developing roller 42 starts to approach the photoreceptor drum 1, the developing roller 42 is started to rotate. The peripheral velocity of the developing roller 42 is assumed the same as that of the photoreceptor drum 1. When the development of the photoreceptor drum 1 is finished and the developing roller 42 is to be separated from the photoreceptor drum 1, the peripheral velocity of the

developing roller 42 is also the same as that of the photoreceptor drum 1.

[0040]

As explained above, the peripheral velocity of these two is the same as each other immediately before the developing roller 42 comes into contact with the photoreceptor drum 1 and immediately before the developing roller 42 separates from the photoreceptor drum 1, and thus, scratches or damages on the two surfaces caused by being rubbed against each other may be prevented from occurring.

[0041]

A layer of the developer in which toner particles are dispersed is formed on the surface of the developing roller 42 before the developing roller 42 comes into contact with the photoreceptor drum 1. Further, when the developing roller 42 is to separate from the photoreceptor drum 1, the layer of the liquid developer 40 containing the dispersed toner is formed.

[0042]

If the layer of the liquid developer 40 with the toner dispersed is not formed on the surface of the developing roller 42 and there is a potential difference between the photoreceptor drum 1 and the developing roller 42, abnormal spark discharge is produced at the time of contact, and the surface of the photoreceptor layer and the surface of the developing roller are damaged. However, by controlling the developing roller 42 so that the layer of the liquid developer 40 is formed immediately before the developing roller 42 is brought into contact with the photoreceptor drum 1 or immediately before the developing roller 42 is separated from the photoreceptor drum 1, the liquid developer 40 can function as an electrically insulated layer, thus preventing spark discharge.

[0043]

A predetermined potential is applied to the surface of the photoreceptor drum 1 so that the toner does not move from the developing roller 42 to the photoreceptor drum 1 immediately before the developing

roller 42 is brought into contact with the photoreceptor drum 1 or immediately after the developing roller 42 is separated from the photoreceptor drum 1.

[0044]

For example, a potential (including 0V) corresponding to the condition of the non-image portion is applied to the surface of the photoreceptor drum 1. Accordingly, waste of toner can be prevented when the developing roller 42 is brought into contact with or separate from the photoreceptor drum 1.

[0045]

Assuming that the surface of the photoreceptor drum 1 is not in a condition for the non-image portion, when the developing roller 42 comes into contact with the photoreceptor drum 1 or separates from the photoreceptor drum 1, unnecessary toner movement occurs from the developing roller 42 to the photoreceptor drum 1 in any other part except the image formation area, and toner is therefore wasted. However, in accordance with the embodiment of this invention, a predetermined potential is applied to the surface of the photoreceptor drum 1 so that the toner does not move from the developing roller 42 to the photoreceptor drum 1 immediately before the developing roller 42 is brought into contact with the photoreceptor drum 1 or immediately after the developing roller 42 is separated from the photoreceptor drum 1. Thus, the surface of the photoreceptor drum 1 satisfies the condition for the non-image portion, which enables to prevent the toner from being wasted.

[0046]

That is, in the embodiment of this invention, the photoreceptor drum 1 and the developing roller 42 are controlled to be rotated so that their peripheral velocity is the same as each other immediately before the developing roller 42 and the photoreceptor drum 1 come into contact with each other. The surface of the photoreceptor drum 1 is charged to satisfy the condition required for the non-image portion, the layer of the liquid developer 40 is formed on the developing roller

42, the photoreceptor drum 1 and the developing roller 42 then contact each other, an electrostatic latent image is formed on the photoreceptor drum 1, and the image is developed and transferred.

[0047]

After the copying is finished, the photoreceptor drum 1 and the developing roller 42 are controlled so that these two are separated while being rotated. The photoreceptor drum 1 is discharged immediately after the developing roller 42 is separated from the photoreceptor drum 1, and the rotation of the photoreceptor drum 1 is stopped. On the other hand, a film layer of the liquid developer 40 is formed on the developing roller 42 and its rotation is stopped, and the developing roller 42 is in a standby state for the next development while keeping this state.

[0048]

In this embodiment, $d1/V<0.5$ is obtained, where a distance from the developing roller 42 to the sweep roller 43 in the rotating direction of the photoreceptor drum 1 is d1 and a linear speed (peripheral velocity) of the photoreceptor drum 1 is v.

[0049]

Where the unit of the distance dl in the rotating direction is mm and the unit of the linear speed v of the photoreceptor drum 1 is mm/sec.

[0050]

Similarly, $d2/V<0.7$ is obtained, where a distance from the sweep roller 43 to the transfer position of the transfer device 5 in the rotating direction of the photoreceptor drum 1 is d2.

[0051]

This is because when the toner image formed on the surface of the photoreceptor drum 1 passes through the sweep roller 43, the image quality is prevented from being degraded due to distortion that may occur at the time of transfer of the toner image to the transfer paper P by the transfer device 5.

[0052]

That is, the toner particles 52 adhering to the surface of the photoreceptor drum 1 align as shown in Fig. 3(a) immediately after being developed. This alignment occurs due to Coulomb attractive force between the charges of the photoreceptor drum 1 and the toner particles 52, and due to the image force (attractive force) produced through formation of a mirror image of the toner particles 52 on the photoreceptor drum 1. However, Coulomb repulsive force acts between the toner particles 52. In particular, the Coulomb repulsive force is dominant in the toner particles 52 on the top layer forming fine dots and fine lines, the Coulomb attractive force is scattered and moved in the carrier liquid 53 with the passage of time. And, as schematically shown in Fig. 3(b), the toner particles 52 are fluctuated, whereby the toner image is distorted.

[0053]

If the toner image passes through the sweep roller 43 in this distorted state, this distortion is further worsened, and the image quality is degraded. Further, distortion occurs by the time the toner image moves from the sweep roller 43 to the transfer device 5, and thus, the image quality is degraded.

[0054]

Therefore, the inventor of this invention carried out experiments under the conditions explained below as shown in Fig. 4, and obtained an image degradation-time characteristic curve indicating a relation between a passing time from when the toner image has passed through the developing roller 42 until it reaches the sweep roller 43, and degradation of the toner image, and obtained also an image degradation-time characteristic curve indicating a relation between a passing time from when the toner image has passed through the sweep roller 43 until it reaches the transfer position of the transfer device 5, and degradation of the toner image.

[0055]

As understood from the result of the experiments shown in Fig. 4, if the passing time of the toner image from the developing roller

42 to the sweep roller 43 is within 0.5 sec, an allowable level of image quality can be maintained.

[0056]

The reason is considered because, before the toner particles 52 are dispersed and moved by the Coulomb repulsive force, the electric field may be applied again to the toner particles 252 so that the toner layer is compressed.

[0057]

As understood from the result of the experiments shown in Fig. 5, if the passing time from the sweep roller 43 to the transfer position is within 0.7 sec, an allowable level of image quality can be maintained.

[0058]

The image degradation-time characteristic curve shown in Fig. 5 has a smooth slope as compared to the image degradation-time characteristic curve shown in Fig. 3. Further, the reason why the passing time of the toner image from the sweep roller 43 to the transfer position may sufficiently be within 0.7 sec, is because the excess carrier liquid 253 on the photoreceptor drum 1 is removed, the amount of the carrier liquid 53 on the photoreceptor drum 1 is reduced, and thus, the movement and dispersion of the toner particles 52 are suppressed.

[0059]

Experimental Conditions

Average particle size of toner . . . 4 μm

Layer thickness of the toner liquid developer (carrier liquid 53) on the photoreceptor drum 1 . . . 8 μm

Viscosity of the carrier liquid 253 . . . 100 cSt

Charged amount of toner 52 . . . 150 uc/g

Photoreceptor drum 1 . . . Amorphous silicon photoreceptor

Surface potential of the photoreceptor drum 1 . . . 600 V

[0060]

[Effects of the Invention]

According to the invention as described in claim 1, permanent distortion of the developing roller due to the pressure/contact may be eliminated and the reliability and durability of the developing roller may be improved.

[0061]

According to the invention as described in claim 2, when the developing roller comes into contact with the latent image carrier or separates from the latent image carrier, both the developing roller and the latent image carrier are configured to be rotating. Therefore, an abrasion and breakage of the developing roller and the latent image carrier caused by being rubbed against each other may be prevented.

[0062]

According to the invention as described in claim 3, damage of the surface of the developing roller or the surface of the latent image carrier due to an abnormal discharge occurring immediately before the developing roller comes into contact with the photoreceptor or immediately after the developing roller separates from the photoreceptor may be prevented.

[0063]

According to the invention as described in claim 4, toner dissipation may be prevented when the developing roller comes into contact with the latent image carrier or separates from the latent image carrier.

[0064]

According to the invention as described in claim 5, a time required until the contact part of the photoreceptor with the developing roller reaches the sweep roller is set to 0.5 sec or below, thus obtaining excellent developing characteristics with less image degradation.

[0065]

According to the invention as described in claim 6, a time required until the contact part of the photoreceptor with the developing roller reaches the sweep roller is set to 0.7 sec or below,

thus obtaining excellent developing characteristics with less image degradation.

[0066]

According to the invention as described in claim 7, the liquid developing device is made of amorphous silicon having a high dielectric constant, thus improving an effective developing electric field.

[Brief Description of the Drawings]

[Fig. 1]

Fig. 1 is a cross-sectional view of a liquid developing device according to the present invention and shows a state in which a developing roller is in contact with a photoreceptor drum.

[Fig. 2]

Fig. 2 is an explanatory view showing a state where the developing roller separates from the photoreceptor drum.

[Fig. 3]

Figs. 3 show alignment states of the toner particles adhering to the portion of the electrostatic latent image on the surface of the photoreceptor drum. Fig. 3(a) shows the state immediately after being developed, and Fig. 3(b) shows the state when 0.5 sec has passed after being developed.

[Fig. 4]

Fig. 4 is a diagram showing an image degradation-time characteristic curve indicating a relation between a passing time from when the toner image has passed through the developing roller until it reaches the sweep roller, and degradation of the toner image.

[Fig. 5]

Fig. 5 is an image degradation-time characteristic curve indicating a relation between a passing time from when the toner image has passed through the sweep roller until it reaches the transfer position of the transfer device, and degradation of the toner image.

[Reference Numerals]

1 Photoreceptor drum (Latent image carrier)

40 Liquid developer

42 Developing roller

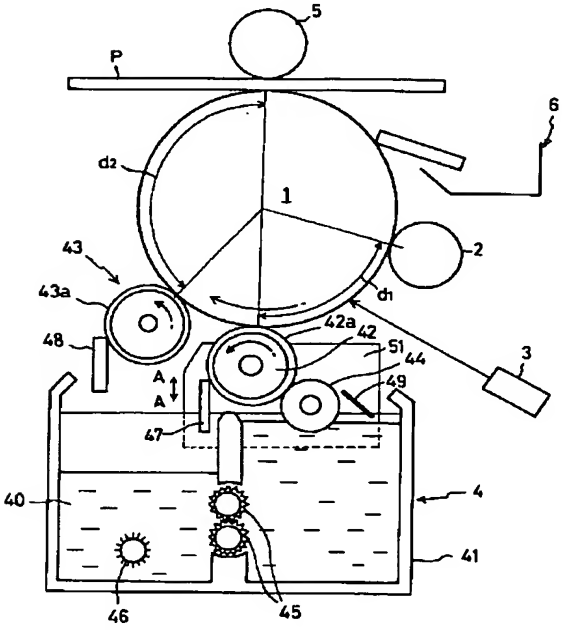
43 Sweep roller

52 Toner

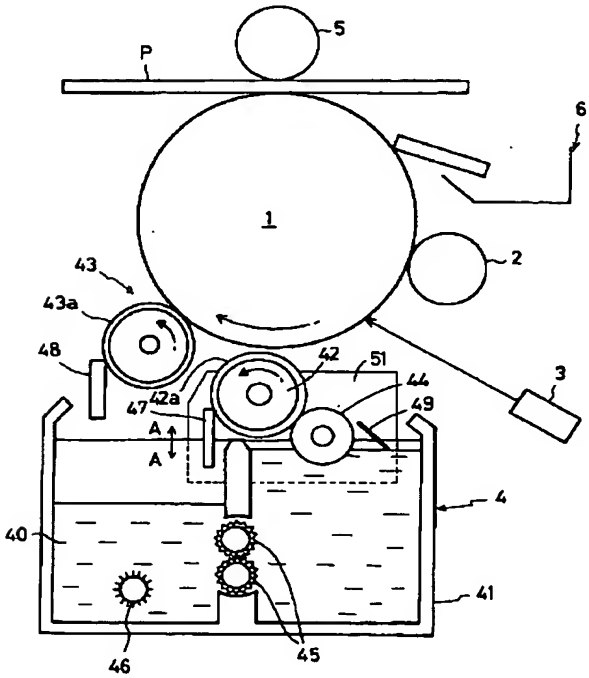
53 Carrier liquid

[Name of Document] Drawing

[Fig. 1]



[Fig. 2]



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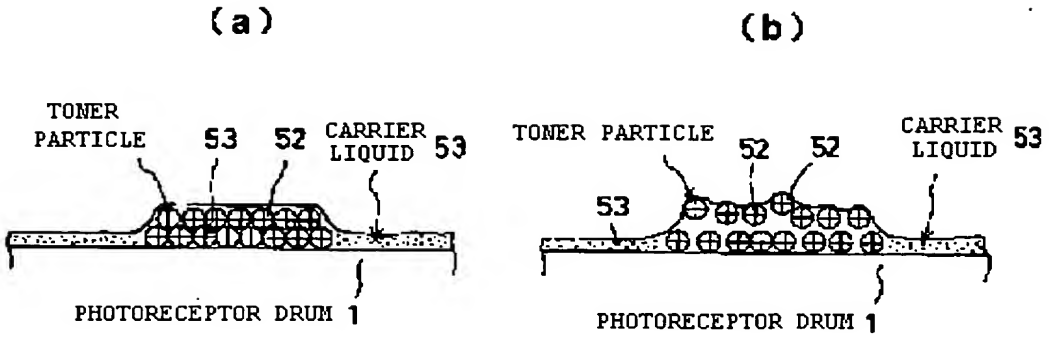
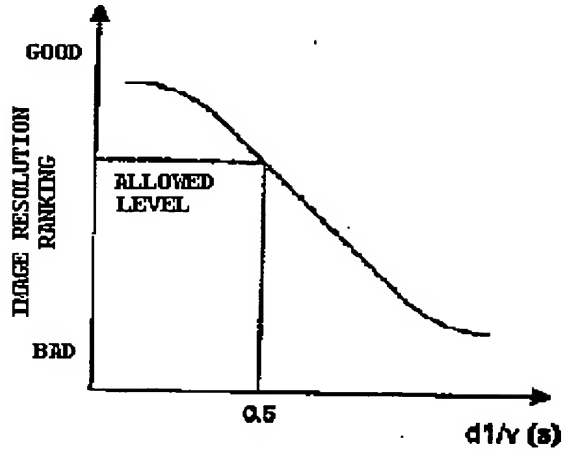
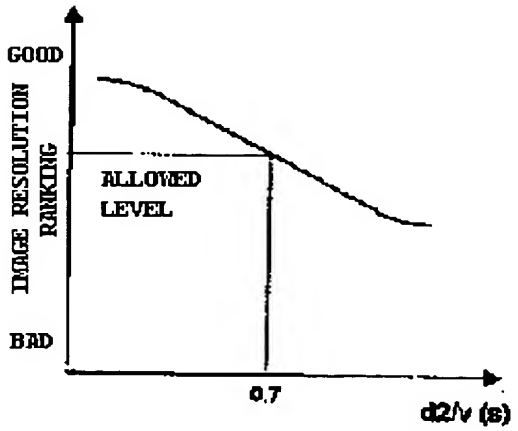


[Fig. 4]



[Fig. 5]



[Name of Document] Abstract

[Abstract]

[Objectives] To provide a liquid developing device in which distortion of a developing roller is eliminated.

[Means for Achieving the Objectives]

A liquid developing device that applies a liquid developer 40 consisting of a carrier liquid 53 and toner 52 dispersed therein to an elastic developing roller 42, brings the developing roller 42 by pressure into contact with a latent image carrier 1 where an electrostatic latent image is formed, develops the electrostatic latent image using the liquid developer 40 applied to the developing roller 42, and simultaneously removes the toner adhering to the background of the latent image carrier 1 using a sweep roller 43, and the liquid developing device is so configured that the developing roller 42 comes into contact with and separates from the latent image carrier 1.

[Selected Drawing] Fig. 1